

B R E V I O R A

Museum of Comparative Zoology

CAMBRIDGE, MASS.

JUNE 9, 1952

NUMBER 4

A UNIQUE REMOPLEURIDID TRILOBITE

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INTRODUCTION

The species described below, and made the type of a new genus, has been known for more than 75 years. Previous illustrations are both few and inadequate, and no attempt had been made to reconstruct the exoskeleton. When such an attempt is made (text-fig. 1) this unique remopleuridid is shown to have been a most unusual trilobite, in which the long, forked hypostome reached back to the anterior margin of the pygidium. It could not enroll, as it would seem that many (or most) trilobites could. If the hypostome was rigidly attached to the cephalic doublure, then only very restricted movements of the thorax and pygidium, relative to the cephalon, were possible.

I am indebted to Dr. G. Arthur Cooper, U. S. National Museum, Washington, D. C., for allowing me to study and photograph material in his charge.

SYSTEMATIC DESCRIPTION

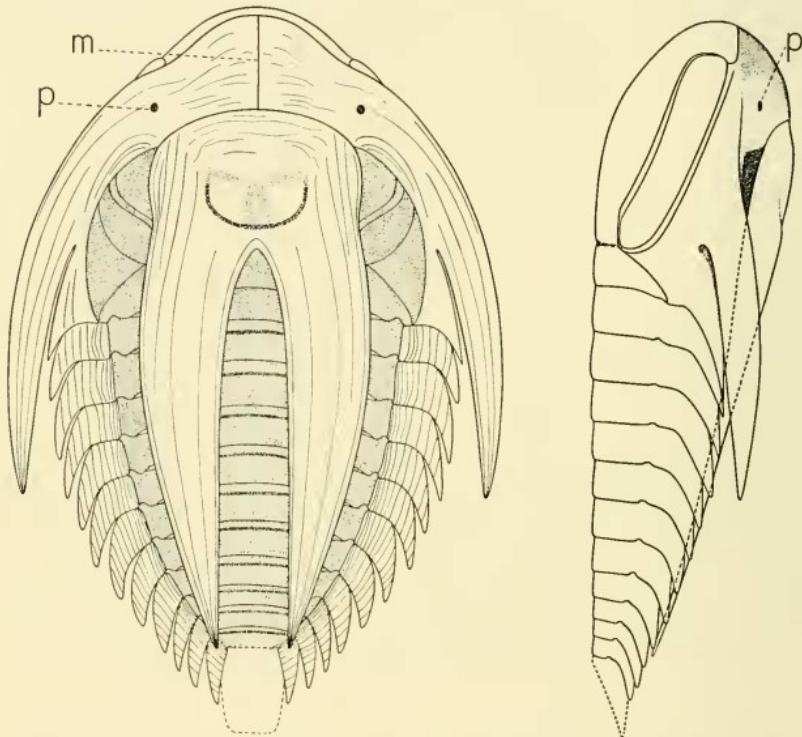
Family REMOPLEURIDIDAE Hawle and Corda, 1847

Genus *HYPODICRANOTUS* gen. nov.

Type species. *Remopleurides striatulus* Walcott, 1875, pp. 347-349, fig. 27, from C. D. Walcott's locality in the Trenton limestone of Trenton Falls, Oneida Co., New York.

Discussion. The cephalon of *Hypodicranotus striatulus* differs from that of the type species of *Remopleurides* (Whittington, 1950, pp. 540-

543, Pl. 70, figs. 1, 2, 4, 5) in that: (a) the anterior part of the glabella, the tongue, projects for a greater distance in front of the eyes; (b) three pairs of glabellar furrows are present, and the second is relatively farther back than that of *Remopleurides*; (c) the broad spine that curves back beside the thorax is not the genal spine, but a lateral cephalic spine; (d) the hypostome is long and deeply forked, not a



Text-figure 1. *Hypodicranotus striatulus* (Walcott, 1875). Reconstructions of ventral (left) and right lateral (right) appearance of outline of exoskeleton, approx. X 3, based upon M. C. Z. Nos. 1616, 1617. The positions of the raised lines on the cephalic and thoracic doublure and the hypostome are indicated in the ventral view. *m* = median suture; *p* = pit in doublure. In both drawings a general outline of the pygidium is indicated by dotted lines.

sub-rectangular plate wider than long. The thorax of *Hypodicranotus* probably consists of eleven segments, and is like that of *Remopleurides*, with the wide axis, prominent articulating processes and sockets, diagonal pleural furrows, and backwardly curved and pointed pleurae.

The axial and pleural furrows in *Hypodicranotus* are shallow, there are no axial spines, and no segment has the pleural spines exceptionally elongated. The pygidium of *Hypodicranotus* is poorly known, but appears to be rectangular in outline, longer than wide, with the axis much shorter than that of *Remopleurides*. The dorsal exoskeletons of other remopleurid genera may readily be distinguished from that of *Hypodicranotus* or *Remopleurides*.

Hypodicranotus is known from the Trenton Group of New York and Ontario, from rocks of the same age in Wisconsin, the Prosser limestone of Minnesota, the Kimmwick limestone of Missouri and Illinois, the Viola limestone of Oklahoma, and from the Ordovician strata at Silliman's Fossil Mount, Baffin Island.

HYPODICRANOTUS STRIATULUS (Walcott, 1875)

Plate 1, figs. 1-10; text-figure 1.

Lectotype (selected Raymond, 1925, explanation of Plate 3). Mus. Comp. Zool. No. 1616, original of Walcott, 1875, p. 347, fig. 27A, from the dark-gray colored Trenton limestone of Trenton Falls, Oneida County, New York. The large collection from this locality in the Museum of Comparative Zoology includes the trilobites *Ceranurus plenrexanthemus* Green, 1832; *Calliops calicephalus* (Hall, 1847); *Leonaspis ? trentonensis* (Hall, 1847); *Diancanthaspis ? parrula* (Walcott, 1879); *Illaenus cf. americanus* Billings, 1859; *Isotelus gigas* DeKay, 1824; *Flexicalymene senaria* (Conrad, 1841), as well as bryozoans, brachiopods, crinoids and asteroids. This locality, from which both W. P. Rust and Walcott collected, is probably in the Denmark member of the Sherman Fall formation of Kay (1937, pp. 267-268).

Paratypes. Mus. Comp. Zool. Nos. 1617, 1618, 1537, same locality and horizon. Additional material, cranidia and hypostomes, is included under Mus. Comp. Zool. Nos. 3267-3269. No. 1617 is original of Walcott, 1875, p. 347, fig. 27a.

Description. Dimensions of lectotype, Mus. Comp. Zool. No. 1616, in millimetres:

Cephalon:

Length (sagittal)	10.4
" (exsagittal)	18.2
Width at genal angle	16.4
Height at second glabellar furrow	6.5
Maximum width across palpebral lobes	11.2
Length of eye lobe	7.2

Thorax:

Width axis first segment	10.2
" ninth " ,approx.	4.3
" first segment (across tips of pleurae)	13.6
" seventh segment (across tips of pleurae)	7.7
Length (sagittal) complete thorax, approx.	13.0

Dimensions of hypostome, Mus. Comp. Zool. No. 1617, in millimetres:

Length (sagittal)	5.2
" (exsagittal)	20.2
Maximum width (at about half the length)	7.4
Width of middle body	3.7

The cranium includes the occipital ring, glabella and tongue, and palpebral lobes. The occipital ring is longitudinally flat, transversely moderately convex, bounded laterally by the posterior branches of the facial sutures, which are straight but run diagonally back from the posterior corner of the eye lobe, then curve to run into the posterior margin at right angles. Inside and parallel to the suture is a faint depression, the axial furrow, and just inside the point where the suture cuts the posterior margin is a rounded notch, the articulating socket. The occipital furrow is shallow. Between the eye lobes the glabella and palpebral lobes are gently and evenly convex both longitudinally and transversely. In the mid-line the tongue of the glabella of the lectotype projects forwards 1.8 mm. in front of the eye lobe, and is convex and bent down so that the anterior part overhangs the sutural margin. There are three pairs of glabellar furrows, visible because they are both unornamented and slightly depressed (Pl. 1, figs. 2, 4). Each furrow runs in a curve convex forwards, and they are equally spaced from each other, the distance (exs.) between them slightly less than the equal distance (exs.) of the outer end of the first from a point opposite the posterior end of the eye lobe, and the outer end of the third from a point opposite the anterior end of the eye lobe. The furrows commence a short distance inside the palpebral furrow, and do not extend to the mid-line. The first is the most strongly convex, the second commences farthest out, and the third farthest in. The palpebral rim is flat, depressed slightly below the lobe, outwardly sloping, widest posteriorly, narrowing forwards and disappearing at the anterior end of the eye lobe. Posteriorly the palpebral furrow runs into the junction of the extremity of the occipital furrow and the axial furrow. The eye lobe is long, in dorsal aspect curved, most strongly in the posterior part. The eye surface is gently convex

transversely, and slopes steeply. The arrangement of the minute, convex facets is shown in Plate 1, figure 10. The outer margin of the eye lobe is defined by a narrow, convex border which commences at the posterior corner and runs forwards to merge anteriorly with the border of the cheek. The anterior branches of the faecal suture curve to run at first forwards and inwards from the outer, anterior, corner of the eye lobe, and then run inwards and upwards to the mid-line. Thus in anterior aspect (Pl. 1, fig. 5) the margin of the tongue is a curve convex upwards. The free cheek is triangular in outline, outwardly sloping, widest behind the eye lobe, the genal spine short and pointed. The cheek narrows forwards to disappear opposite the anterior part of the eye lobe. From the lateral border opposite the median part of the eye lobe a broad spine curves back, narrowing and reaching to a point opposite the axis of the fifth thoracic segment. The inner margin of the proximal part of this spine is parallel to, and just outside of, the outer margin of the cheek and genal spine. The doublure of the cephalon is broad anteriorly, gently convex, crossed by a median suture. Antero-laterally and laterally the doublure is narrower and bent upwards. A small pit is situated on the exsagittal line passing through the anterior end of the eye lobe, and about mid-way across the doublure (Pl. 1, fig. 8; text-fig. 1). The hypostome is long and forked, and its position relative to the rest of the exoskeleton is shown in text-figure 1. It is gently convex, in both longitudinal and transverse directions, the transverse convexity greatest at the curved anterior margin. The convexity (in ventral view) is interrupted only by the shallow depression in the median region just in front of the crotch of the fork. The middle body is circular in outline, faintly elevated, defined postero-laterally by a distinct furrow. It is divided into three sub-equal sections by shallow radial depressions, the strongest leading back to the crotch of the fork, the other two directed antero-laterally (Pl. 1, fig. 7). On the inside of the exoskeleton of a smaller specimen (Pl. 1, fig. 9) these sections appear more pronounced, and on both sides the postero-lateral pair are the more prominent. Anteriorly the middle body merges with the border, and the anterior wings appear to be short, triangular, and upwardly directed. Each postero-lateral border is extended as a prong of the fork, the inner margin of the prong straight, the outer margin curved, so that the maximum width of the hypostome is in front of half the length, and the prong tapers to a sharp point. The doublure of the hypostome (Pl. 1, figs. 4, 9) is narrow along the lateral border, but extends in under the fork to a line almost under the margin of the middle body.

The inner edge of the doublure is flexed up sharply. *Mus. Comp. Zool.* No. 1618 (Pl. 1, fig. 4) shows that the doublure of the prong is convex dorsally, with a low, median, longitudinal ridge.

The thorax is moderately convex transversely, the axis broad, narrowing rapidly backwards. It seems to consist of eleven segments. On the left side of the lectotype 10 segments can clearly be seen (Pl. 1, fig. 2). Behind this only what may be part of the left pleura of the eleventh segment, and part of the pygidium, are preserved. Another specimen (Pl. 1, fig. 6) shows ten partly disarticulated segments and an incomplete pygidium. The last segment has the pleura pointing almost directly posteriorly, whereas that next in front has the pleura directed back and slightly outwards, and the lateral margins are curved. This penultimate segment is very like the tenth of the lectotype. The axial ring is moderately convex transversely, the articulating furrow shallow, the articulating half-ring of length (sag. = sagittal) about half that of the ring (Pl. 1, fig. 6). There is no axial furrow as such, but inside the articulating sockets and processes a triangular area (broadest anteriorly) of the outermost part of each ring is slightly depressed. The inner margin of this area is a diagonal curved line sub-parallel to the pleural furrow. The articulating process, on the anterior margin of the segment, is slightly raised as well as forwardly projecting. Postero-laterally the inflation is continued across the pleura as a low, curved ridge, dying out at about two-thirds (exs. = exsagittal) the length. This ridge, and a depression on the inner side, define the pleural furrow. The pleurae are gently convex (tr. and exs.), outwardly sloping, the narrow (tr. = transverse) inner part directed transversely, the outer part curved back and pointed. The shape and inclination of the pleurae are shown in Plate 1, figures 1, 2, 6.

Only a small part of the pleural lobes of the pygidium is preserved in the lectotype. The only other specimen known (Pl. 1, fig. 6) is also incomplete. The outline was evidently rectangular, longer than wide, the ill-defined axis convex, short, and wide. Behind and beside the axis the pleural lobes slope down in a curve concave in longitudinal profile. The lateral and posterior margins, and the doublure, are unknown.

Scattered over the cranidium, but largest and most closely spaced on, and adjacent to, the palpebral lobes (though absent from the palpebral rim), are small crescentic depressions, the points of the crescent facing forwards, and the concave, anterior margin raised (Pl. 1, figs. 1, 2, 4). Similar but larger structures are present on the

free cheeks, the genal spine, and the base and outer part of the long lateral spine (Pl. 1, fig. 1). There is a tiny median tubercle on the occipital ring, closer to the furrow than the posterior margin. Faint, small crescentic depressions are scattered on the median part of the axis of the thorax. Strong, well-spaced, raised lines run approximately longitudinally on the inner part of the lateral cephalic spine, the thoracic pleurae, and on the doublure of these areas and the cheeks (Pl. 1, figs. 1-4, 6, 8). The lines tend to run in curves convex inwards on the dorsal surface of the pleurae, and transversely in curves convex forwards on the dorsal surface of the pygidium. On the inner part of the doublure of the thoracic pleurae, however, they run in curves concave inwards. These lines die out on the median part of the cephalic doublure, and are replaced by faint, anastomosing, transverse grooves. On the lateral borders and fork of the hypostome (Pl. 1, fig. 7) the longitudinal lines are strongest, and that which runs just inside the inner margin of the prongs is a prominent ridge. The middle body shows a faint pattern of narrow, anastomosing ridges running longitudinally on the postero-lateral sectors. On the anterior sector of the middle body and the anterior border, fine, well-spaced, anastomosing grooves, like those on the median part of the cephalic doublure, run transversely.

Discussion. This species was first described by Walcott (1875, pp. 347-349, fig. 27), and the original material later redescribed by Raymond (1925, pp. 57-58, Pl. 3, figs. 4, 5). An incomplete craniidium from the same general locality as the type (U. S. Nat. Mus. 92528) was also figured by Foerste (1920, p. 222, Pl. 22, figs. 18 A-C). Raymond (1921, p. 31, Pl. 9, fig. 7) described a hypostome from the Middle Trenton of Trenton, Ontario, and referred it to *H. striatus*, and stated that a craniidium had also been found at Governor Bay, near Ottawa. Specimens kindly loaned to me by Professor G. Winston Sinclair, from the Middle Trenton of Lakefield, Ontario, contain craniidia and hypostomes like those of the type material. A second species of *Hypodicranotus* is *H. missouriensis* (Foerste, 1920, pp. 220-222, Pl. 21, fig. 17; Pl. 22, figs. 17A, 17B; Bradley, 1930, pp. 246-247, Pl. 30, figs. 4-9) from the Kimmiswick limestone of Missouri and Illinois. The type material (U. S. Nat. Mus. No. 78438) includes craniidia and a hypostome. The outline of the latter, and the prominence of the postero-lateral areas of the middle body, distinguish it from *H. striatus*. The characteristic hypostome of *Hypodicranotus* also occurs in the Trenton of Duck Creek Quarry, near Green Bay, Wisconsin (U. S. Nat. Mus. Nos. 72181, 87687), the Prosser limestone

of St. Paul, Minnesota (U. S. Nat. Mus.), and I have collected one from about 100 ft. above the base of the Viola limestone, in the road cut on U. S. highway 77, in Carter County, 2½ miles north of Springer, Oklahoma. The matrix at this locality was a finely-granular, light grey-brown limestone, which yielded abundant graptolites and the trilobites *Cryptolithoides ulrichi* Whittington, 1941, *Trinodus* sp., *Robergia* sp., and an asaphid. The specimen figured by Roy (1941, p. 155, fig. 114), as *Remopleurides* sp., from Silliman's Fossil Mount, Baffin Island, seems also to be the hypostome of this genus. The genus thus occurs in central and eastern North America in rocks of Trenton age, and the Baffin Island beds may be of a similar age.

The exoskeleton of *Hypodieranotus striatus*, apart from the hypostome, is like that of other remopleuridids of Middle Ordovician age, e.g. the Irish specimens (Whittington, 1950, pp. 540–543, Pl. 69, figs. 5–10, Pl. 70, figs. 1–6) and undescribed species from the Edinburg limestone of Virginia. The latter have a sub-rectangular hypostome, not forked, like that of the type species (Whittington, 1950, Pl. 70, fig. 2). The posterior margin reaches back to a point lying no farther back than the occipital furrow. The long, forked hypostome of *Hypodieranotus* is not only unique, so far as is known, among remopleuridids, but its relatively great length is in excess of that of any other trilobite known to me. It is evident that here is one genus of trilobites that could not enroll.

The pit in the antero-lateral cephalic doublure (Pl. 1, fig. 8, text-fig. 1) is a feature which I have observed in several different species of Middle Ordovician remopleuridids. Silicified specimens show the pit to be the opening of an upwardly-directed tube, which narrows inwards and terminates near the lower, anterior corner of the eye surface. The position and nature of this opening do not suggest that it is homologous with the Panderian opening, which, if present in the cephalon, is situated in the postero-lateral cephalic doublure. Not all remopleuridids appear to show this opening (e. g. those described by Ross, 1951, pp. 84–91, Pl. 20, do not), and I have not observed a similar opening in any other group of trilobites.

It is tempting to speculate on the mode of life of the holaspisid *Hypodieranotus*. It occurs in company with shallow-water marine forms, many of which are indisputably benthonic. The long hypostome prevented enrollment, but did provide some protection for the ventral surface. If no movement was possible at the hypostomal suture, then the amount of possible movement of the thorax and pygidium in the vertical plane, relative to the cephalon, must have been severely

limited. The mode of articulation of the thorax precludes any considerable movement relative to the cephalon in the horizontal plane. There is ample room for the appendages to project downwards and outwards between the hypostome and the thoracic pleurae. But we know nothing of the type of appendage possessed by remopleuridid trilobites, and without this information have little basis for speculation on the mode of locomotion, manner of feeding, etc. Was *Hypodiceranotus* a burrowing, crawling, floating, or swimming form? No definite answer is possible but I am inclined to think of it as either floating or swimming.

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